

# **Revisiting Nigeria’s Remittances- Growth Nexus: The Roles Of Financial Inclusion As A Moderator And Mediator Using Dynamic Gmm**

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## **Abstract**

*Remittances can reduce capital limitations, facilitate household consumption, and stimulate economic growth in recipient economies. Concurrently, there has been a notable rise in financial inclusion, improving access to and utilization of financial services. Nevertheless, there is still inconsistent evidence in the literature on the transmission roles of financial inclusion and the relationship between remittances and economic growth. This study examines the moderating and mediating effects of financial inclusion in Nigeria alongside the direct effect of remittances on economic growth. A Financial Inclusion Composite Index based on access, usage, and quality dimensions was constructed using annual data from the Central Bank of Nigeria from 1981 to 2024. Estimation was conducted using the Generalized Method of Moments (GMM) and unit root tests. The results show that financial inclusion has a negative and insignificant effect on economic growth, but remittances have a positive and insignificant effect on economic growth. These imply that remittances are mostly sent through informal channels and are primarily used for consumption rather than productive investment, reflecting weak financial intermediation in the formal sector; in addition, financial inclusion moderates but does not mediate the relationship between remittances and economic growth. To optimize the developmental impact of remittances, this study suggests policies targeting SME finance, encouraging diaspora bonds, optimizing credit allocation and lending efficiency, and strengthening institutional quality.*

**Keywords:** *Remittances, Financial Inclusion Composite Index, Moderation, Mediation, GMM*

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## **I. Introduction**

Unequal employment opportunities in home countries among the skilled citizens (Onyike et al., 2020) have necessitated the recent surge of migration into developed economies in search of better economic opportunities, consequently, financial repatriation back home has also increased even surpassing foreign direct investment and official aid with the potential to alleviate capital limitations, smoothen household consumption and aid economic growth especially in developing countries (Awdeh & Jomaa, 2024) in addition, access to financial institutions and the use of their services have also increased over time. However, the effect of repatriation inflows on economic growth and the transmission roles of financial inclusion of such effect are sources of controversy among researchers which limits policy formulation and implementation. The money repatriated otherwise called remittances is formally defined by Ratha (2003) as funds sent by migrants to their home countries to support consumption, improve household welfare and provide needed funds for investment, it affects income distribution, poverty reduction, savings, investment and economic growth at the macro level, it also smoothen consumption at the micro level, however, Chami et al. (2005) asserted that remittances could induce dependency, reduce labour supply, and unintentionally, provoke domestic currency appreciation, import dependence, diversion of capital into non tradable investments and ultimately lead to economic recession, otherwise called the Dutch disease.

The expansion of the formal channels of repatriating remittances back to home countries compliments remittance surge and is within the ambit of financial inclusion. This is defined by Dermirguc-kunt et al. (2018) as the extent to which households and businesses have access to and effectively use financial services such as insurance, savings, loans and fund transfer. Key dimensions of financial inclusion therefore include; access, usage and quality, while some authors used indices that are exclusive to only one dimension, those that used a composite index did not include all the dimensions in its construction thereby ignoring the multidimensional nature of financial inclusion, furthermore, researchers have attempted to empirically provide a linkage between remittances and economic growth, the quantitative increase in the production of goods and services in a country is referred to as economic growth (Todaro & Smith, 2020)

In Nigeria, between 1981 and 2024 several economic policies were implemented to elicit increased trade openness, market driven exchange and interest rates and domestic products that are competitive globally, within this period, remittances as measured by net current transfer show an increasing trend over time. It has a mean of ₦3,122.948 billion, a maximum value of ₦35,575.19 billion in 2024 with a minimum of value of ₦-346.5 billion in 1981, furthermore, its high standard deviation within the period evidenced high volatility. All the selected indices of financial inclusion show increasing trend over time, number of commercial bank's branches which measures financial inclusion access was highest in 2010 at 5,809 branches and lowest in 1981 at 869 branches with an average branch of 3,444 across the study period. The total bank deposit measures the usage dimension of financial inclusion having a mean value of ₦13,479.65 billion, a maximum value of ₦113,355.1 billion in 2024 and a minimum value of ₦6.25 billion in 1981, it however varies widely within the sample period because of its high standard deviation.

Credit to the private sector as a percentage of gross domestic product (GDP) measures the quality dimension of financial inclusion, it shows considerable stability with a standard deviation of 4.2% and ranged between a maximum of 19.62% in 2009 and a minimum of 3.83% in 1993 with an average of 9.5%. The GDP similarly shows increasing trend overtime with a mean value of ₦51,224.36 billion, a maximum of ₦277,293.8 billion in 2024 and a minimum value of ₦139.31 billion in 1981 with an average of ₦51,224.36 billion within the sample period.

Beyond the increasing trajectory of all the discussed variables over time which is typical of time series data, there is the need to measure the actual effect of remittances on economic growth and test the transmission role of financial inclusion on the relationship. This will be done using a composite index to test whether financial inclusion is a moderator or a mediator.

Again, past researchers have reported contrasting results on the association between remittances and economic growth, while some reported positive association (Khan et al., 2025; Tu et al., 2019), some reported negative association (Peprah et al., 2019), controversy equally exist in literature regarding the nature of interaction between remittances and financial inclusion in affecting economic growth, while Tu et al. (2019) concluded that financial inclusion mediates remittances to affect growth, Garba et al. (2020) opined that quantitative financial inclusion indices serve a complementarity role while the qualitative measures serve the role of a substitute to remittances.

This study looks at the moderating and mediating effects of financial inclusion in Nigeria as well as the direct impact of remittances on economic growth. The specific objectives of this study are to; determine the effect of remittances on economic growth, establish the effect of remittances on financial inclusion, ascertain the effect of financial inclusion on growth, examine the moderating role of financial inclusion in the nexus between remittances and growth and test the mediating role of financial inclusion in the nexus between remittances and growth. This study will therefore contribute to knowledge by jointly ascertaining the moderating and mediating roles of financial inclusion composite index in the remittance's growth nexus in Nigeria, using a method that accommodates endogeneity in the independent variables. After this introduction, section two reviews the conceptual, theoretical and empirical literatures, section three discusses the methodology, section four contains the results and discussion, and the paper ends with conclusions in section five.

## **II. Literature Review**

### **Conceptual Review**

Remittances are funds sent by migrants to their home countries to support household consumption, welfare and investment, the channels of repatriation could be formal channels (banks, money transfer operators, mobile money platforms) or informal channels (friends, relatives or unregistered agents) (Ratha, 2003). Especially in developing economies, remittances have proven to be a stable and significant source of external finance even surpassing foreign direct investment and official aids. Remittances have been adjudged to be countercyclical since their inflows tends to be stable or even increasing during recession. Remittances influence income distribution, poverty reduction, savings, investment and economic growth at the macro level. However, the demerits of increased remittance inflow include its potential to induce dependency, reduce labour supply and provoke the Dutch disease syndrome (Chami et al., 2005).

Theories and empirical evidences have established the link between remittances and economic growth or development, this review attempts to distinguish between economic growth and economic development. Economic growth refers to the quantitative increase in the production of goods and services in a country, it is usually measured by Gross Domestic Product (GDP), Gross National Product (GNP) or per capita income (Todaro & Smith, 2020), economic development on the other hand is a broader concept than economic growth, it refers to economic growth plus improvement in the welfare and quality of life of citizens. Economic development is usually measured using the Human Development Index (HDI), literacy rates, life expectancy, poverty reduction and income distribution (Sen, 1999; Todaro & Smith, 2020). A functional and stable financial system can improve savings and when intermediated efficiently towards investment in tradable sector, it will lead to economic growth,

when such growth translates to improvement in citizens welfare, improved living conditions, reduced poverty and equitable opportunities, economic development is experienced.

By attracting funds from the surplus sector and channeling such funds to the deficit sector for investment, financial system plays a critical role in translating savings into growth, financial inclusion and financial development are therefore key concepts in the remittances, savings and growth nexus. Financial inclusion is defined as the extent to which businesses and individuals have access to and effectively use affordable financial services such as insurance, savings, loans and funds transfer systems (Dermirguc-Kunt et al., 2018). Aside access to financial services, effective use of financial services connotes usage that meets users' needs emphasizing quality of the financial services, thus, three dimensions of financial inclusion can be identified, access, usage and quality. Affordability emphasizes the right price, right mode and convenient place are also embedded in quality. On the other hand, financial development is broader and incorporates financial inclusion, financial deepening, financial efficiency and financial stability (Levine, 1997), in other words, financial development implies improvement in financial system depth (size and liquidity), efficiency (cost and productivity of financial intermediation), stability (resilience to internal and external shocks) and Inclusion (access usage and quality). Although financial inclusion is a subset of financial development, they can be negatively correlated, a country with high financial development may experience low financial inclusion and vice versa. However, the objective of financial inclusion is to ensure that the attained level of financial development cascades to all citizens especially the financially excluded. Financial inclusion has a nuanced and direct effect on remittances, that is access and usage of quality financial products encourage remittance inflow which can be intermediated for economic growth and household welfare, this underscores the choice of financial inclusion as a moderator or mediator in this study.

### **Theoretical Review**

Relevant theories to this study are thematized into three; the remittance and growth theories, the finance and growth theories, and the remittance and financial inclusion theories. For the remittance and growth theories, reviewed theories include, the New Economics of Labour Migration (NELM) theory and the Dutch disease hypothesis. The NELM theory advances the view that economic migration decisions are collectively made by household with the objective of diversifying income sources, minimizing risk and overcoming market imperfections particularly in developing economies (Stark & Bloom, 1985). This view differs from the neoclassical view that migration is borne out of individual decision and wage driven. The theory argued that remittances sent home is a form of informal insurance against consumption shocks and an alternative to formal credit channels due to imperfect financial market and poorly developed institutions especially in developing economies. According to Taylor (1999), remittances provide informal insurance by helping to smoothen household consumption during shocks and thereby mitigating poverty risk. Furthermore, remittances can also be used to finance productive investment (Stark, 1991) by providing needed micro credit that are not available from formal channels. A properly developed financial system, complimented by improved financial inclusion will encourage the intermediation of remittances for production of goods and services.

However, increased remittances may appreciate domestic currency and crowd out domestic investment and production, this is the view of the Dutch disease hypothesis, it suggests that substantial foreign inflow from remittances, natural resource revenues or foreign aid can have negative effect on economic growth especially in the long run. The concept emanated from the experience of the Netherlands, the country witnessed appreciation of their domestic currency and decline in the competitiveness of their tradable sector following the discovery of natural gas in the 1960s. the theory postulates that increased foreign currency inflows have two effects thus; the spending effect and the resource movement effect. The spending effect refers to increased consumption of non-tradable goods (Corden, 1984) and the appreciation of domestic currency while the resources movement effect is the crowd out of resources and investment away from the tradable sector and diverted into the now profitable non tradable sector that now enjoy greater patronage due to surge in foreign currency inflow. These effects combine to reduce export competitiveness, encourage import dependence and weaken industrial development; however, a well-developed and functional financial system can reverse these negative effects through efficient intermediation that will increase savings, investment and production.

Reviewed theories in the finance and growth nexus include; the endogenous growth theory, the financial intermediation theory, the supply leading hypothesis and the demand following hypothesis. The endogenous growth model posits that economic growth is driven by internal factors of human capital, innovation and knowledge accumulation (Romer, 1986; Lucas, 1988). This contradicts the neo classical view which believes that growth is driven by the external factor of technologies. Central to the endogenous growth model is the opinion that institutions and the financial system play critical roles in the economic growth process, it argues that an efficient financial system mobilizes savings, efficiently allocates capital for productive use and support entrepreneurship and innovation, it also ensures that the population can access financial services and invest in tradable ventures. (Levine, 1997).

The financial intermediation theory is of the view that financial development facilitates economic growth by mobilizing savings, allocating capital efficiently and reducing transaction and information costs. By encouraging savings and channeling such into deficit units for production, the financial system enhances investment in the productive sector and ensure efficient allocation of capital (Schumpeter, 1911; Levine, 1997).

However, there is a debate about whether financial development should precede economic growth or vice versa, the supply leading hypothesis argues that financial development precedes and drives economic growth (Mckinnon,1973; Shaw,1973), conversely, the demand following hypothesis opined that economic growth precedes and drives financial development (Robinson,1952). These theories have established the critical role of financial development and by extension financial inclusion to encourage savings which is channeled into investment in the tradable sectors leading to economic growth, this assertion will be empirically tested in this study, using economic indices in Nigeria.

The Complementarity and the Substitutability hypotheses describes the nexus between remittances and financial inclusion. The complementarity hypothesis asserts that financial development and remittances compliment and reinforce each other, aside consumption smoothening, a well-developed financial system allows households to save and invest remittance inflow in productive sector of the economy which will ultimately lead to economic growth, (Giuliano & Ruiz-Arraz, 2009). In contrast, the substitutability hypothesis holds that remittances substitute for a weak or poorly developed financial system, it preaches that remittances provide alternative source of funding for household consumption smoothening, insurance and productive investment. This is particularly prevalent in developing countries with poorly developed financial system, high collateral requirements, cost and documentation requirements combine to make obtaining loan funds from formal financial institutions difficult or impossible, this is particularly true among small scale and upcoming entrepreneurs. The complementarity role of financial inclusion as a moderator or mediator in the nexus between remittances and growth will be subjected to empirical examination in this study.

### **Empirical Review**

Reviewed literature concentrated on four key areas, the first group of researchers examined the remittances growth nexus and actively investigated the transmission roles of financial inclusion. The second thematic group, investigated the association between remittances and financial inclusion, the third group looked at the relationship between remittances and savings while the last group examined the financial inclusion and growth nexus.

The nexus between remittances inflows, financial inclusion and economic development was investigated by Tu et al. (2019), the study employed the Generalized Method of Moment (GMM) with a composite financial inclusion index constructed using the access and usage dimensions of financial inclusion, the study concluded that remittances and financial inclusion work jointly to aid economic development within different income groups, however, the non-use of the quality dimension of financial inclusion when constructing the financial inclusion index used may limit the applicability of the study's conclusion, likewise, Peprah et al. (2019) ascertained the linkages between financial development, remittances and economic growth in Ghana using dynamic heterogeneous autoregressive distributed la (ARDL) model but contrarily concluded that financial development are not growth enhancing and that certain level of financial development can be detrimental to growth, financial development indices were used in the study as against financial inclusion index which encompassed financial inclusion, financial deepening, efficiency and stability of the financial system and the difference in result from earlier study may be due to the wider dimension of financial development. Garba et al. (2020), similarly examined the role of the financial sector in the relationship between foreign remittances and economic growth in Nigeria between 1981 and 2015 using 2 stage least square but concentrated on the complementarity and substitutability between foreign remittances and financial development in promoting economic growth, the study opined that the complementarity and substitutability between foreign remittances and financial development in promoting economic growth depends on the financial development indices used, while quantitative indicators confirmed complementarity, qualitative indicators confirmed substitutability. This confirms that the scope and type of financial system index used as transmission variable may significantly affect its role, this, unclear role of financial system in the growth remittance nexus was avoided by Onyike et al. (2020), who investigated the effect of international remittances on economic growth in Nigeria between 1986 and 2017 using the Autoregressive Distributed Lag (ARDL) model. The study modelled growth as dependent on remittances, gross domestic investment, interest rate and inflation rate, without making attempt at gauging the transmission role of financial inclusion, in addition, theoretically, the model's independent variables display endogeneity and GMM will be a better method to use in this case. The paper concludes that remittances, human capital and inflation had positive effect on growth in the long run, while in the short run, human capital, Gross domestic income, remittances and inflation had positive effects, however interest rate had negative effect on growth.

Chuc et al. (2022) investigated the combined impact of international remittance inflow and financial inclusion on economic growth using data of 60 countries from 1996 to 2017, the financial inclusion index used

was constructed using Principal Component Analyses (PCA), and concluded that financial inclusion strengthens the growth enhancing effect of remittances. PCA as used in this study ensures a data driven weighing system and minimized multicollinearity and information loss inherent in other aggregation methods, however, it may be complex making interpretation to be clumsy. Furthermore, Khan et al. (2025) examined the role of financial inclusion in explaining the association between remittances and economic growth in developing countries, it employed panel data for 79 countries from 2011 to 2021 using Random effect, Fixed effect and generalized method of moment (GMM). The study concludes that remittance has a positive association with economic growth, and this effect is amplified in countries with higher level of financial inclusion and robust human capital, although PCA was used to capture the financial inclusion index, the study model did not clearly capture the interaction of financial inclusion and remittances in affecting economic growth. A synthesis of the literatures in this section reveals a controversy on the effect of remittances on economic growth, diverse measure of financial inclusion was also noticed with many not capturing the multidimensional nature of financial inclusion, the use of regression methods that does not accommodate endogeneity in data and failure to ascertain the exact role of financial inclusion as a moderator or a mediator in the remittance- growth nexus, these gaps will be addressed in this study.

The second group of studies focused on the association between remittances and financial inclusion, Machasio (2018), tested the effect of remittances on financial inclusion in 61 developing countries using data from 1990 to 2014. The study used a constructed financial inclusion index and its data were analyzed using fixed effects and instrumental variable GMM, the study concluded that remittances have an impact on financial inclusion through their effect on financial development. The use of GMM to analyze obtained data and a constructed composite financial inclusion index agrees with contemporary trends, however, absence of the test of causal relationship between the variables may confuse policy recommendations, causality tests confirms or denies the presence of endogeneity to justify the usage or non-use of GMM, it is also necessary in testing the transmission role of a variable, this will be addressed in this study, Tu et al. (2019) similarly measured the association between remittances and financial inclusion and affirmed that remittances encouraged financial inclusion. Arthur et al. (2020) introduced a moderator in the nexus, the study tested the moderating effect of diaspora policy of the Kenya government on the association between diaspora remittances and financial inclusion using the longitudinal and explanatory non experimental research design. The study concluded that diaspora remittances have a positive and significant effect on financial inclusion, however, while the use of longitudinal design may help in addressing endogeneity it introduces more grave issues of dynamic endogeneity, challenges of interpretation, simultaneity, unobserved heterogeneity and data limitations. This study addresses this by insisting on the use of GMM. Oyelami and Ogundipe (2020) expanded the study's scope by investigating the effects of migrants' remittances on financial inclusion using pooled mean form of panel ARDL. Variables used in the model included remittances, account ownership and income per capita for 27 sub-Saharan African countries. The study concluded that remittances have no significant effect on financial inclusion in Sub Saharan Africa which is contrary to the conclusion of earlier reviewed works, in addition, the use of access as the only indicator of financial inclusion overlooks the multidimensional nature of financial inclusion. This will be addressed in this study with the use of an all-encompassing composite financial inclusion index. The third identified theme focused on the remittances savings and financial inclusion nexus, a logical theoretical transmission channel for remittances that leads to growth is; remittances to financial institution, leading to increased savings and then intermediated into productive sector leading to growth, this channel was empirically tested by Osei-Gyebi et al. (2023), the study ascertained the effect of remittance inflow on savings and the moderating role of financial inclusion on the nexus between remittance inflow and savings in Nigeria. A binary logit model was employed using the World Bank survey data on 3000 Nigerians. The study discovered that, mobile account holders have higher propensity to save, receivers of remittances have higher propensity to save and lastly, those that have bank account and also receive remittances tends to save more. This confirms that financial inclusion improves the effect of remittances on savings, the study's model regressed remittances on financial account ownership, age, gender, education level and wage level. Remittances and bank account ownership formed the interaction variable that measured moderation. The study integrated demography in the growth savings, remittances and financial inclusion nexus and attempted to test the transmission mechanism through savings, however, the use of the Logit regression model and a unidimensional financial inclusion index limits the rigor of the investigation. Lastly, Obayori et al. (2020), examined the association between financial inclusion and economic growth in Nigeria between 1981 and 2018 using the ARDL model, the study established that access and usage of financial services significantly increased economic growth in both the short run and the long run, however, the use of ARDL does not fully mitigate endogeneity, cannot handle simultaneous relationships and imposes a unidirectional structure, the use of multidimensional and composite financial inclusion index, potential endogeneity and dynamic interactions envisaged in the current study necessitates the use of GMM and causality testing.

### III. Methodology

The study adopts the ex post facto research design, stemming from the fact that the data used are past economic data that cannot be manipulated, study's data are secondary and mainly sourced from the Central Bank of Nigeria Statistical Bulletin. The data used, represent Nigeria economic indices from 1981 to 2024.

#### Model Specification

A combination of the New Economics of Labour Migration (NELM) and the Endogenous Growth theories guide the model formulation. The study equally adapts the model used by Khan et al. (2025), their study regressed GDP on remittances (R), financial inclusion (FI) and other control variables testing FI as a mediator thus:

$$GDP = f(R, FI, HDI, INC, TO, GEXP, INF, FDI) \dots\dots\dots 1$$

Where, HDI is human development index, INC is income, TO stands for trade openness, GEXP is government expenditure, INF is inflation and FDI is foreign direct investment.

To achieve deeper focus, this study drops all the control variables and used exchange rate (EXR) and interest rate (INT) instead, thus the baseline equation becomes.

$$GDP = f(NCT, FI, EXR, INT) \dots\dots\dots 2$$

Where net cash flow (NCT) is used to proxy remittances. Using the Generalized Method of Moments (GMM) method of regression to handle endogeneity and dynamics and adapting it to the time series data used in the study, the lag value of GDP is added as additional independent variable,  $\beta_0 - \beta_5$  are the coefficients and  $\epsilon$  is the error term, the model becomes

$$GDP_t = \beta_0 + \beta_1 GDP_{t-1} + \beta_2 NCT_t + \beta_3 FI_t + \beta_4 EXR_t + \beta_5 INT_t + \epsilon_t \dots\dots\dots 3$$

#### The Moderation Model

To test the moderation model (interaction effect), the product of NCT and FI that is, (NCT x FI) will form the interaction variable, however using original value of NCT will increase multicollinearity and the interaction term becomes unstable, thus the GDP and EXR are log transformed, while the NCT is IHS (inverse hyperbolic sine) transformed because logarithm transformation of NCT will result into loss of data in years where its values are negative. Finally, to obtain the interaction variable, both IHS transformed NCT and FI are mean centered, and used both as such for both the constituent terms and interaction term. This is better for interpretability as the coefficients are evaluated at the mean values for the involved variables. (Aiken & West, 1991; Cohen et al., 2003)

NCT is IHS transformed thus

$$IHS(NCT) = \log [NCT + \sqrt{(NCT)^2 + 1}] \dots\dots\dots 4$$

And mean centering of IHS(NCT) and FI are obtained thus

$$IHS(NCT)^* = IHS(NCT) - \text{Mean } IHS(NCT) \dots\dots\dots 5$$

$$FI^* = FI - \text{mean } (FI)$$

The moderation equation then becomes

$$\log GDP_t = \beta_0 + \beta_1 \log GDP_{t-1} + \beta_2 IHSNCT_t^* + \beta_3 FI_t^* + \beta_4 (IHS(NCT)_t^* \times FI_t^*) + \beta_5 \log EXR_t + \beta_6 INT_t + \epsilon_t \dots\dots\dots 6$$

#### The Mediation Models

Financial inclusion will be a mediator if it translates the effect of remittances (NCT) into economic growth (GDP), that is the flow should be NCT to FI to GDP, therefore NCT must have a significant effect on FI and FI must have a significant effect on GDP. Using the traditional method (Baron and Kenny, 1986), the mediation estimation requires three models, the first measures the effect of remittances (NCT) on financial inclusion (FI) thus:

$$FI_t = \alpha_0 + \alpha_1 FI_{t-1} + \alpha_2 IHSNCT_t + \alpha_3 \log EXR_t + \alpha_4 INT_t + \epsilon_t \dots\dots\dots 7$$

The second is the growth equation with FI as one of the independent variables

$$\log GDP_t = \delta_0 + \delta_1 \log GDP_{t-1} + \delta_2 IHSNCT_t + \delta_3 FI_t + \delta_4 \log EXR_t + \delta_5 INT_t + \epsilon_t \dots\dots\dots 8$$

while the third is the growth equation without FI

$$\log GDP_t = \gamma_0 + \gamma_1 \log GDP_{t-1} + \gamma_2 IHSNCT_t + \gamma_3 \log EXR_t + \gamma_4 INT_t + \epsilon_t \dots\dots\dots 9$$

Financial inclusion will then be a mediator if  $\alpha_2$  and  $\delta_3$  are significant, If  $\delta_2 < \gamma_2$  and  $\delta_2$  is significant there is a case of partial mediation and if  $\delta_2$  not significant, there is a case of full mediation.

#### Construction of the Financial Inclusion Composite Index

##### Method of estimation

This study adopts the generalized method of moment (GMM) method, the method has the unique The financial inclusion index will be constructed using the simple average method, however, each of the component variable will be standardized using Z-score normalization. This is necessary to achieve scale uniformity, the average of the standardized variable then becomes the composite financial index thus:

Given,  $Z(X_t) = [X_t - \text{mean}(X_t)]/\sigma_x$ .....10

Where  $\sigma_x$  is the standard deviation of variable X

With Financial inclusion indices of number of commercial bank branches (NOB) measuring the access dimension, bank deposit (BDEP) measuring usage dimension and credit to the private sector as a percentage of GDP (CPSGDP) measuring the quality dimension, the z scores of the variables become

$Z(\text{NOB}_t) = [\text{NOB}_t - \text{mean}(\text{NOB}_t)]/\sigma_{\text{NOB}}$  .....11

$Z(\text{BDEP}_t) = [\text{BDEP}_t - \text{mean}(\text{BDEP}_t)]/\sigma_{\text{BDEP}}$ .....12

$Z(\text{CPSGDP}_t) = [\text{CPSGDP}_t - \text{mean}(\text{CPSGDP}_t)]/\sigma_{\text{CPS}}$ .....13

And the final index is obtained as

$\text{FI} = 1/3[Z(\text{NOB}_t) + Z(\text{BDEP}_t) + Z(\text{CPSGDP}_t)]$ .....14

The higher the value of FI, the higher will be the extent of financial inclusion advantage of being able to handle endogeneity in variables and it provides robust standard errors that account for heteroskedasticity and serial correlation in the error terms. Finally, GMM works perfectly with dynamic models. GMM is particularly suitable in this study because, of the potential existence of endogeneity between NCT (remittances), financial inclusion and GDP (economic growth), the study's focus of testing the dynamic form of the model which GMM accommodates with the use of the lagged value of GDP, and finally, because of the potential presence of auto correlation and heteroskedasticity in the study's variables. A condition for the use of GMM is that none of the variables must be integrated at second order I(2), the unit root analysis will be conducted using the Augmented Dickey Fuller (ADF) method to assess this and ensure that the variables are stationary in order to avoid spurious regression.

**IV. Results And Discussion**

**Descriptive Statistics**

Table 1 presents the descriptive statistics of raw values of variables used in the study

Table 1: Descriptive statistics

	EXR	FI	GDP	INT	NCT
Mean	158.7564	1.06E-07	51224.36	17.09701	3122948.
Median	119.7685	-0.339146	12529.21	17.09875	279037.4
Maximum	1478.965	2.537984	277493.8	29.80000	35575190
Minimum	0.610025	-0.939819	139.3105	7.750000	-346.5000
Std. Dev.	247.7464	0.900853	71041.53	4.564462	6016130.
Skewness	3.724790	0.780577	1.536455	0.362721	3.854071
Kurtosis	19.67264	2.685492	4.580196	3.579830	20.54573
Jarque-Bera	611.3674	4.649552	21.88962	1.581195	673.3251
Probability	0.000000	0.097805	0.000018	0.453574	0.000000
Sum	6985.283	4.65E-06	2253872.	752.2684	1.37E+08
Sum Sq. Dev.	2639265.	34.89606	2.17E+11	895.8755	1.56E+15
Observations	44	44	44	44	44

Source: Authors computation 2026

GDP is right skewed, its mean (51,224) being greater than its median (12,529), NCT is extremely positively skewed with mean 3,122,948 and median 279,037 while EXR is moderately right skewed with a mean of 158.8 and a median of 119.8. the mean of financial inclusion index is close to zero which is expected due to the standardization of the variables involved in the construction of the composite index, FI also has a median of -0.34 making it to be slightly negatively skewed. However, interest rate is fairly symmetrical with its mean and median approximately equal to 17. The high skewness of gross domestic product and exchange rate justifies their log transformation while the extreme skewness of net current transfer justifies its IHS transformation. These transformations are necessary to achieve equal scaling and data symmetry.

The standard deviations of GDP (71,041) and NCT (6,016,130) are high which means that they are highly dispersed, exchange rate is also unstable with a standard deviation of 247.7 while FI and INT are relatively stable with standard deviations of 0.9 and 4.56 respectively.

the Jarque-Bera tests of normality are significant in the case of EXR, GDP, and NCT, thus, the study rejects the null hypothesis that the variables are normally distributed, this confirms the need for their transformation, however, the test is not significant in the cases of FI and INT, meaning that they are normally distributed.

**Pairwise Correlation**

The correlation matrix used the transformed variables as employed in the study's model estimations. The matrix is presented in table 2

Table 2: correlation matrix

	LOG (EXR)	FI	FI(-1)	LOG (GDP(-1))	LOG (GDP)	IHSNCT	HIS NCT(-1)	INT	MC FI	MC IHSNCT
LOG(EXR)	1.00	0.80	0.79	0.95	0.96	0.95	0.94	0.13	0.80	0.95
FI	0.80	1.00	0.97	0.88	0.87	0.82	0.82	-0.24	1.00	0.82
FI(-1)	0.79	0.97	1.00	0.89	0.88	0.82	0.83	-0.22	0.97	0.82
LOG(GDP(-1))	0.95	0.88	0.89	1.00	1.00	0.98	0.98	-0.09	0.88	0.98
LOG(GDP)	0.96	0.87	0.88	1.00	1.00	0.98	0.98	-0.07	0.87	0.98
IHSNCT	0.95	0.82	0.82	0.98	0.98	1.00	0.99	-0.01	0.82	1.00
IHSNCT(-1)	0.94	0.82	0.83	0.98	0.98	0.99	1.00	-0.06	0.82	0.99
INT	0.13	-0.24	-0.22	-0.09	-0.07	-0.01	-0.06	1.00	-0.24	-0.01
MC FI	0.80	1.00	0.97	0.88	0.87	0.82	0.82	-0.24	1.00	0.82
MC IHSNCT	0.95	0.82	0.82	0.98	0.98	1.00	0.99	-0.01	0.82	1.00

Source: authors computation 2026

The following pairs have high positive correlations, log of GDP and its one period lag, which implies that GDP is persistent over time, log of GDP and IHSNCT (0.98) which is consistent with growth supporting remittance inflows, and one periods lag of GDP and IHSNCT (0.98). these high correlations suggest high dynamic dependence, but with potential multicollinearity among the GDP and NCT variables. Log of EXR similarly have high positive correlations with log of GDP (0.96) and IHSNCT (0.95) but have weak positive relationship (almost independent) with INT (0.13), this implies that higher exchange rate (currency depreciation) is associated with higher remittances, this is expected and intuitive as higher domestic currency obtained per unit of foreign currency repatriated encourages more inflows.

FI and its mean centered value have a perfect correlation of 1, confirming that mean centering don't alter correlation, again FI and its lag 1 value are also positively and highly correlated (0.97), furthermore, mean centered FI is also positively correlated with log of GDP. These confirm that financial inclusion index is highly persistent over time and its positive correlation with log of GDP (0.87) and IHSNCT (0.82) suggests its mediating role.

Interest rate has a weak negative correlation with log of GDP (-0.07) and FI (-0.24) but has a weak positive correlation with exchange rate (0.13). the low correlation of interest rate with main variables suggests its independence and unlikelihood of causing multicollinearity issues. However, the negative correlation between FI and interest rate suggests that interest rate crowds out financial inclusion and vice versa, higher branch network may result into reduced loan prime rates due to increased competition among banks. NCT and FI are positively correlated with their lag 1 values, this suggest dynamic modeling in the study and a justification for the use of GMM estimation, furthermore, log of GDP and its lag 1 value, IHSNCT and its lag 1 value and log of exchange rate are all presenting strong correlations which is above 0.95, these suggests the presence of multicollinearity in the study data further justifying the use of GMM as the preferred estimation method in the study.

**Unit Root Test**

The unit root test was conducted using the Augmented Dickey Fuller method, in the test equation, the intercept was included and the Akaike Information Criterion (AIC) was used to select the maximum lag length. The test is necessary to ensure that none of the variables are stationary at second difference which a necessary condition for the use of GMM, however, the persistence of log GDP and FI (judged by their correlations with their lag 1 values) determines the choice between difference GMM and system GMM. Where persistence (high correlations) exist, system GMM is appropriate and where not (low correlation) difference GMM will be appropriate. The summary of the unit root result is contained in table 3

Table 3: Summary of unit root test

Variables	Probabilities at level	Probabilities at first difference
Log GDP	0.5833	0.0100
Log EXR	0.6184	0.0002
IHSNCT	0.7200	0.0012
FI	0.9959	0.0033
INT	0.1396	0

Source: Authors computations 2026

Table 3 indicates that, at 5% level of significance, all the variables are stationary at first difference I(1) and none at second difference I(2), this satisfies one of the conditions for the use of GMM, the variables enter into the GMM framework in their first differenced forms which transforms the I(1) variables into stationary series, thus, the variables are not specified in their stationary forms as the differencing transformations are internally handled by GMM, furthermore, with reference to table 2, the high correlations between: log of GDP

and its lag 1 value and FI and its lag 1 value demands for the use the System GMM framework, however e views only provides for Difference GMM, therefore, Difference GMM estimation will be used in this study but with deeper lags used as instruments to mitigate weak instrument issues.

**Results of GMM Estimations**

**The Moderation Equation**

The summary of the estimation results of equation 6 (moderator) is contained in table 4 below

Table 4: GMM estimation results

variables	Moderator	Mediator	Full mediation (growth equation with FI)	Total effect (growth equation without FI)
Dependent	LGDP	FI	LGDP	LGDP
Independent				
C	0.438958 (0.1618)	0.329811 (0.3514)	0.671086 (0.2369)	0.822840 (0.2829)
LGDP(-1)	0.931558 (0)*		0.845103 (0)*	0.821622 (0.0000)*
MC IHSNCT	<b>0.043071 (0.1739)</b>			
MC FI	-0.123238 (0.0483)*			
NCTFI	<b>0.021562 (0.0533)*</b>			
LEXR	0.049468 (0.0265)*	0.202296 (0.0447)*	0.090101 (0.2113)	0.122160 (0.2947)
INT	0.006296 (0.0179)*	-0.038862 (0.0215)*	-0.003653 (0.7791)	-0.005883 (0.7531)
FI(-1)		0.707713 (0.0000)*		
IHSNCT		<b>-0.039499 (0.4972)</b>	0.059791 (0.2053)	<b>0.056980 (0.3026)</b>
FI			<b>-0.008752 (0.8733)</b>	
<b>Diagnostics</b>				
R-squared	0.998796	0.934081	0.998721	0.998662
Durbin-Watson stat	1.436430	1.058051	1.708508	1.745975
Instrument rank	14	8	10	8
J-statistic	5.397026 (0.611632)	2.097157 (0.552488)	.164035 (0.384261)	3.669250 (0.299465)
instruments	LGDP(-2 TO -4) MC IHSNCT(-2 TO -4) MC FI(-2 TO -4) NCTFI(-2 TO -4) LEXR INT	FI(-2 TO -3) IHSNCT(-2 TO -3) LEXR(-2 TO -3) INT(-1 TO -2)	LGDP(-2 TO -3) IHSNCT(-2 TO -3) FI(-2 TO -3) LEXR(-2 TO -3) INT(-1 TO -2)	LGDP(-2 TO -3) IHSNCT(-2 TO -3) LEXR(-2 TO -3) INT(-1 TO -2)

(\*) indicates significant, (probabilities)

Source: Author's computation, 2026.

The direct effect of remittances at average FI is positive but not significant (0.0431, P=0.1739) and the direct effect of FI at average remittances is significant but negative (-0.1232, P=0.0483) which means that higher financial inclusion at average remittances leads to a reduced growth. The moderation effect NCTFI is positive but weakly significant at 10% level (0.02156, P=0.0533), this suggests that financial inclusion increases the growth impact of remittances, the control variables of exchange rate (0.0495, P=0.0205) and interest rate (0.0063, P=0.0179) are positive and significant, that is higher exchange rate (currency depreciation) is associated with higher growth, this reflect the export competitiveness effect and higher interest rate is associated with higher growth which captures the investment responsiveness of interest rate. The behaviors of exchange rate and interest rate underscores the importance of macro stability for growth.

The model's diagnostics are valid and the model is well specified with a high R<sup>2</sup> (coefficient of determination) of 99.88% indicating almost a perfect fit this is expected in a dynamic GMM estimation, there exist some positive autocorrelation (DW= 1.436), the J- statistics (5.3970, P=0.6116) is not significant thereby concluding that the model instruments are valid, in addition, with an instrument rank of 14, the number of sample is appropriate and there is low risk of proliferation.

**The Mediation Equations**

Three equations were estimated thus, the mediator equation that measures the effect of remittances on financial inclusion, the full mediation equation which is the growth equation with financial inclusion as an independent variable and the total effect model which is the growth equation without financial inclusion as an independent variable. In the three equations, financial inclusion, remittances, gross domestic product and exchange rate are treated as endogenous, as such deep lags (2 to 3) are used for the variables when specifying the GMM instruments, however, interest rate is treated as not strictly exogenous but predetermined, thus lags 1 to 2 are used in specifying its instrument. Table 4 contains the summary of the estimation results of all the mediation equations

### **The mediator equation: The effect of remittances on financial inclusion**

The lag one value of financial inclusion (0.707713,  $P=0.0000$ ), is positive and significant, remittances (-0.039499,  $P=0.4972$ ) have negative effect on financial inclusion but not significant in addition, exchange rate (0.202296,  $P=0.0447$ ) is positive and significant while interest rate (-0.038862,  $P=0.0215$ ) is negative and significant the  $R^2$  at 93.4% shows a high fit, while the J statistics ( $P=0.552488$ ) and an instrument rank of 8 indicate that the model instrument is valid and the study's sample size is adequate respectively. However, a Durbin Watson of 1.058051 suggests the presence of autocorrelation.

### **The full mediation model: Growth equation with financial inclusion**

The one period lag of Gross Domestic Product (0.845103,  $P=0$ ) has a positive and significant effect, remittances (0.059791,  $P=0.2053$ ) also have a positive but not significant effect, in addition, financial inclusion (-0.008752,  $P=0.8733$ ) is negative and not significant, exchange rate (0.090101,  $P=0.2113$ ) has positive and not significant effect and interest rate (-0.003653,  $P=0.7791$ ) have negative and not significant effect. The  $R^2$  at 99.88% indicate a high fit, the J- statistics ( $P=0.384261$ ) and instrument rank of 10 suggest that the model instrument is valid and the study's sample size is adequate respectively.

### **The total effect model: Growth equation without FI**

The one period lag of gross domestic product (0.821622,  $P=0.0000$ ) is positive and significant, remittances (0.056980,  $P=0.3026$ ) has a positive and not significant effect, exchange rate (0.12216,  $P=0.2947$ ) similarly has a positive and not significant effect, and interest rate (-0.005883,  $P=0.7531$ ) has a negative and not significant effect. The  $R^2$  at 99.86% indicate a high fit, the J- statistics ( $P=0.299465$ ) and instrument rank of 8 suggest that the model instrument is valid and the study's sample size is adequate respectively.

## **V. Conclusion**

Across all the equations estimated in this study, the effect of remittances on growth is predominantly positive and not significant, Garba et al. (2020) on the contrary reported a negative and significant association while Onyike et al. (2020) reported a positive but significant effect, the study's result implies the possibility that remittance inflows are mainly used by household for consumption smoothening neglecting its use for investment in the production of tradable goods, furthermore, remittances have negative but not significant effect on financial inclusion, this indicates that remittances do not deepen financial inclusion probably because remittance inflows pass through informal channels (friends and unregistered agent). Another deduction from the results is that, financial inclusion has a negative and not significant effect on growth, this means that financial inclusion does not drive growth, there is weak credit allocation, low productive investment and that financial access exists in Nigeria without the corresponding economic transformation. This is partly contrary to the results of Garba et al. (2020) that reported a negative and significant effect of financial inclusion on growth.

The moderation effect of financial inclusion which is measured by the interaction of remittances and financial inclusion is positive and significant, this is equivalent to the submissions of Garba et al. (2020), this infers that financial inclusion enhances the effect of remittances on growth, contrarily, financial inclusion does not act as a mediator in the remittance growth nexus, that is, the effect of remittance is not transmitted to growth through financial inclusion in Nigeria, this is evidenced by the fact that the effect of remittance on financial inclusion is negative and not significant and the effect of financial inclusion on growth is equally negative and not significant.

**Recommendation:** the policy direction should be towards efforts that will channel remittance inflow into investment in the productive sector, encouraging use of formal channels for the remittance inflows, improving the quality of financial services and its moderation effect in enhancing growth through remittance. Specifically, the government should promote Small and Medium Enterprise (SME) financing, establish investment linked financial products, encourage bank-based transfers and the establishment and proliferation of digital platforms. Furthermore, the government should establish diaspora bonds, and avail matching grants to remittance receivers. Financial intermediation should be strengthened by improving credit allocation, promoting lending efficiency and improving institutional quality. Finally, the government should align financial inclusion with growth strategy by supporting financial inclusion efforts through industrialization, entrepreneurship and capital formation

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